THE CONFERENCE & EXPO ON

MOBILE & WIRELESS SECURITY

Session 5

Bluetooth Security: Beyond Bluebug

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Session 5

Adam Laurie, Marcel Holtmann, Martin Herfurt

Tuesday, November 15th, 2005 – 2:45 pm

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Agenda

- Bluetooth technology overview
- The security mechanisms
- Known vulnerabilities
- Tools that are used
- Live demonstration

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Who is investigating

- Adam Laurie
  - CSO of The Bunker Secure Hosting Ltd.
  - DEFCON staff and organizer
- Marcel Holtmann
  - Maintainer of the Linux Bluetooth stack
- Martin Herfurt
  - Security researcher
  - Founder of *trifinite.org*

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What is this about

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What is Bluetooth

- Bluetooth SIG
  - Trade association
  - Founded 1998
  - Owns and licenses IP
- Bluetooth technology
  - A general cable replacement
  - Using the ISM band at 2.4 GHz
  - Protocol stack and application profiles

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How it works

- Data and voice transmission
  - ACL data connections
  - SCO and eSCO voice channels
- Piconet and scatternet topology
- Frequency hopping
  - 79 channels
  - 1600 hops per second

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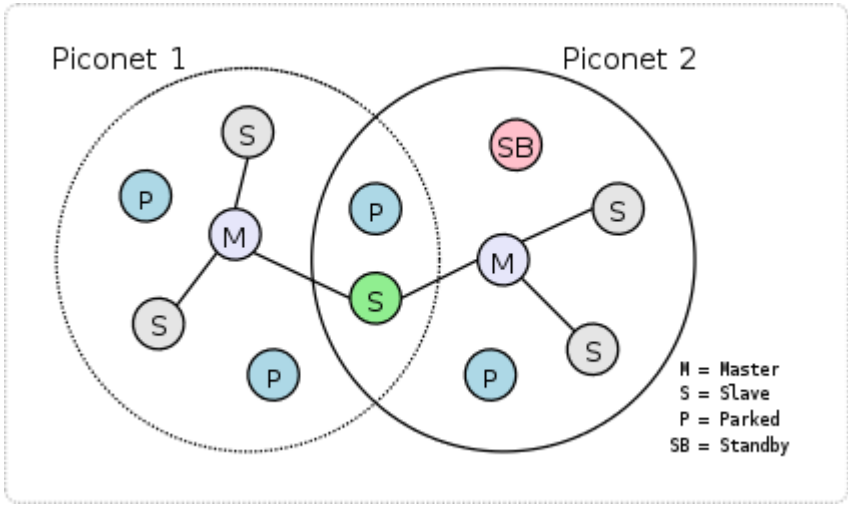
Creating the topology

- Hopping sequence defines the piconet
  - Master defines the hopping sequence
  - Up to seven active slaves
  - Scatternet creation



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Bluetooth architecture

- Hardware layer
  - Radio, Baseband and Link Manager
  - Access through the Host Controller Interface
    - Standards for USB and UART
- Host protocols
  - L2CAP, SDP, RFCOMM, BNEP, AVDTP etc.
- Application profiles
  - Serial Port Profile, Dialup, PAN, A2DP, HID etc.

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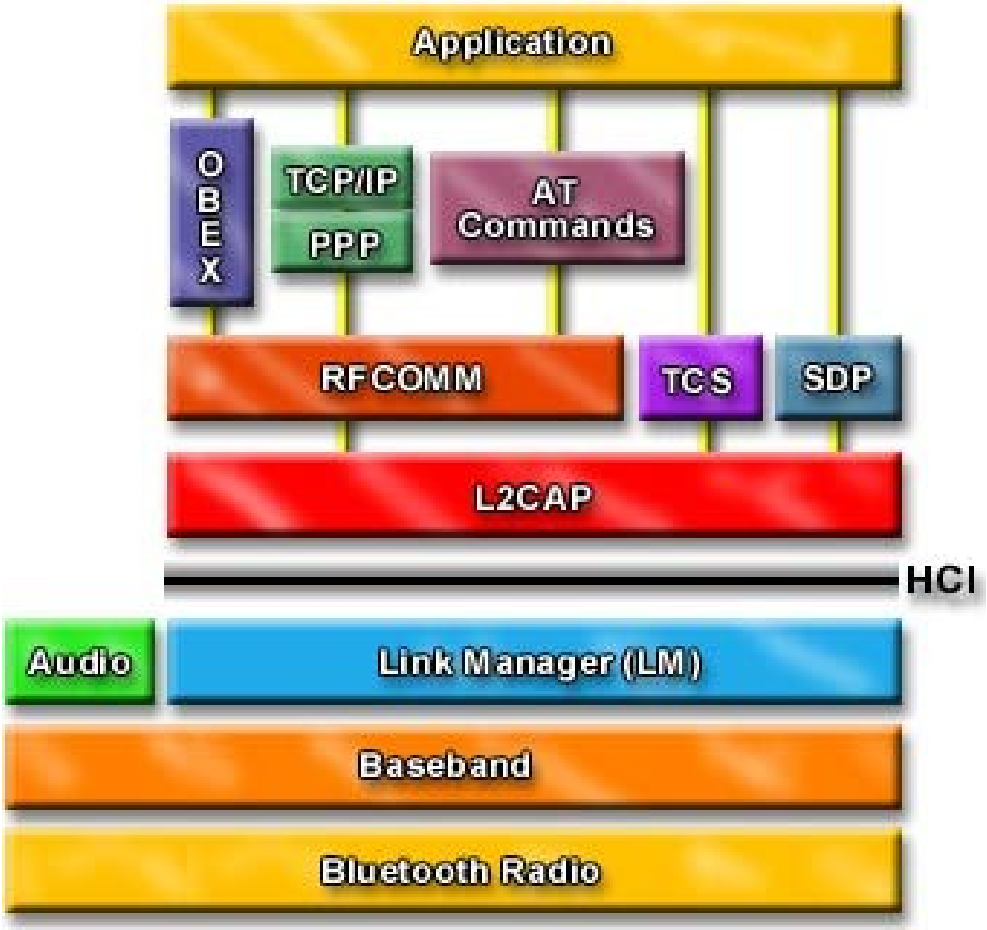
Bluetooth stack



Application specific security mechanisms

Bluetooth host security mechanisms

Security mechanisms on the Bluetooth chip

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Bluetooth security

- Link manager security
  - All security routines are on-chip
  - Nothing is transmitted in “plain text”
- Host stack security
  - Interface to the link manager security
  - Part of the HCI specification
  - Easy interface
  - No further encryption of pin codes or keys

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Bluetooth link keys

- Needed for authentication
- Used for encryption
  - SAFER+ (128 bit block cipher)
- Generated by pairing process
  - Passkey (1-16 alphanumeric characters)
  - Random number (from device internal clock)
  - BD_ADDR of piconet master

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Security modes

- Security mode 1
  - No active security enforcement
- Security mode 2
  - Service level security
  - On device level no difference to mode 1
- Security mode 3
  - Device level security
  - Enforce security for every low-level connection

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Security commands

- Settings
  - HCI_{Read|Write|Delete}_Stored_Link_Key
  - HCI_{Read|Write}_Authentication_Enable
  - HCI_{Read|Write}_Encryption_Mode
- Actions
  - HCI_Authentication_Requested
  - HCI_Set_Connection_Encryption
  - HCI_Change_Connection_Link_Key

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Pairing functions

- Events
  - HCI_Pin_Code_Request
  - HCI_Link_Key_Request
  - HCI_Link_Key_Notification
- Responses
  - HCI_Pin_Code_Request_[Negative_]Reply
  - HCI_Link_Key_Request_[Negative_]Reply

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How pairing works

- First connection
  - (1) > HCI_Pin_Code_Request
  - (2) < HCI_Pin_Code_Request_Reply
  - (3) > HCI_Link_Key_Notification
- Further connections
  - (1) > HCI_Link_Key_Request
  - (2) < HCI_Link_Key_Request_Reply
  - (3) > HCI_Link_Key_Notification (optional)

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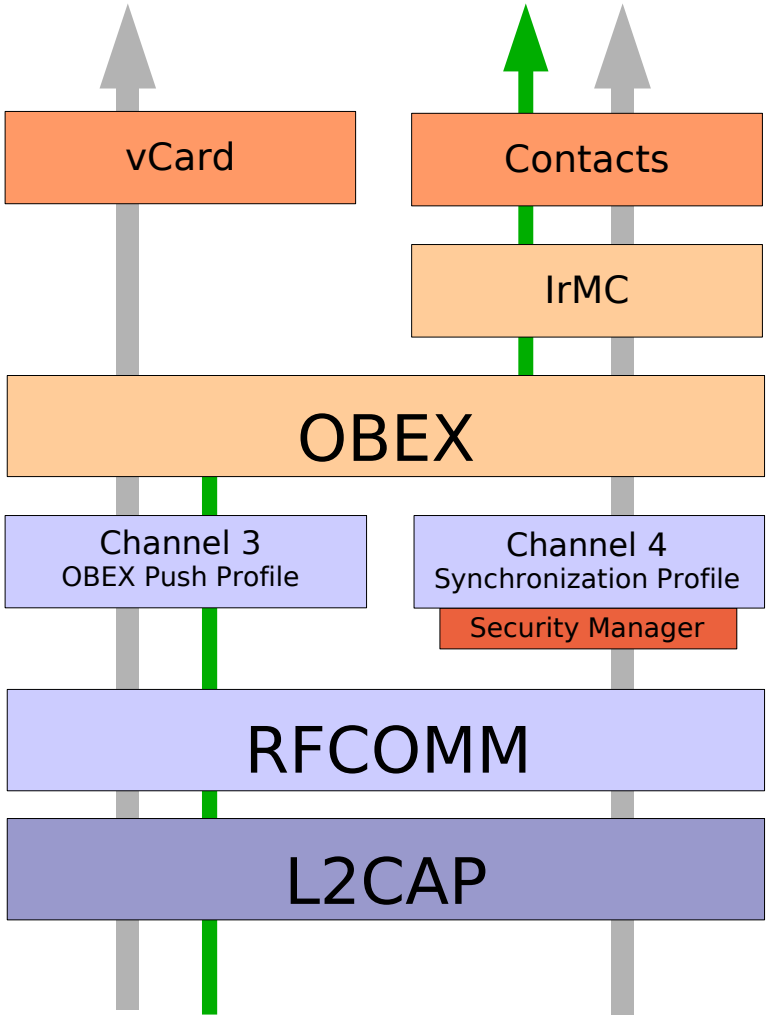
How to avoid pairing



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BlueSnarf

- Trivial OBEX push attack
  - Pull knows objects instead of pushing
  - No authentication
- Discovered by Marcel Holtmann
  - Published in October 2003
- Also discovered by Adam Laurie
  - Published in November 2003
  - Field tests at London Underground etc.

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BlueBug

- Issuing AT commands
  - Use hidden and unprotected channels
  - Full control over the phone
- Discovered by Martin Herfurt
  - Motivation from the BlueSnarf attack
  - Public field test a CeBIT 2004
- Possibility to cause extra costs

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HeloMoto

- Requires entry in “My Devices”
- Use OBEX push to create entry
  - No full OBEX exchange needed
- Connect to headset/handsfree channel
  - No authentication required
  - Full access with AT command
- Discovered by Adam Laurie

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Authentication abuse

- Create pairing
  - Authenticate for benign task
  - Force authentication
  - Use security mode 3 if needed
- Connect to unauthorized channels
  - Serial Port Profile
  - Dialup Networking
  - OBEX File Transfer

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BlueSmack

- Using L2CAP echo feature
  - Signal channel request and response
  - L2CAP signal MTU is unknown
  - No open L2CAP channel needed
- Causing buffer overflows
- Denial of service attack

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BlueStab

- Denial of service attack
  - Bluetooth device name is UTF-8 encoded
  - Friendly name with control characters
  - Crashes some phones
  - Can cause weird behaviors
  - Name caches can be very problematic
- Credits to Q-Nix and Collin R. Mulliner

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BlueBump

- Forced re-keying
  - Authenticate for benign task (vCard exchange)
  - Force authentication
- Tell partner to delete pairing
  - Hold connection open
  - Request change of connection link key
- Connect to unauthorized channels

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BlueSnarf++

- OBEX push channel attack, again
  - Connect with Sync, FTP or BIP target UUID
  - No authentication
  - Contents are browseable
  - Full read and write access
  - Access to external media storage
- Manufacturers have been informed

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BlueSpooof

- Clone a trusted device
  - Device address
  - Service records
  - Emulate protocols and profiles
- Disable encryption
- Force re-pairing

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BlueDump

- Yanic Shaked and Avishai Wool
  - http://www.eng.tau.ac.il/~yash/Bluetooth/
  - Expands PIN attack from Ollie Whitehouse
  - Requires special hardware or firmware
- Destroy trust relationship
  - Use the BlueSpooof methods
- User interaction for pairing still needed

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Blueprinting

- Fingerprinting for Bluetooth
- Work started by Collin R. Mulliner and Martin Herfurt
- Based on the SDP records and OUI
- Important for security audits
- Paper with more information available

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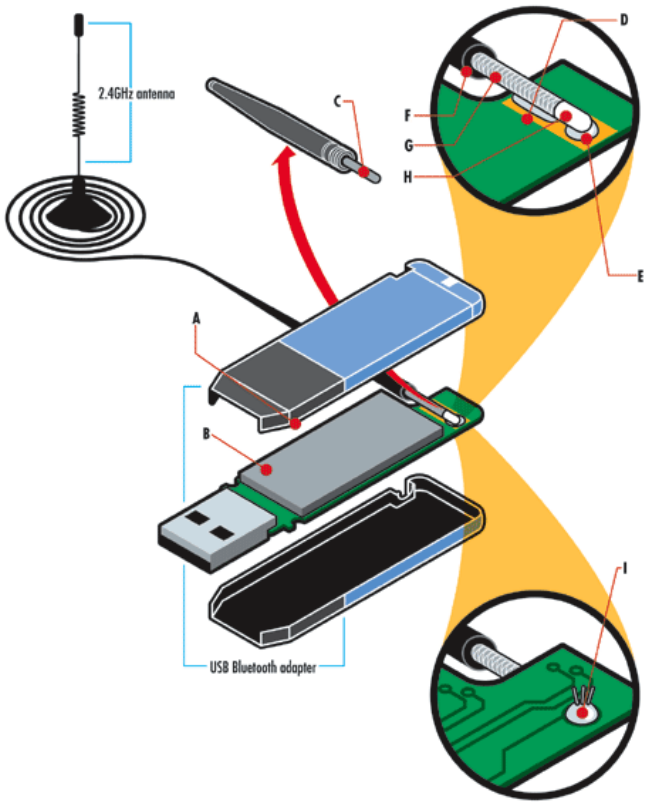
Bluetooone

- Enhancing the range of Bluetooth dongle with a directional antenna
- Long distance attack after DEFCON 12
- Snarfing over 1,78 km



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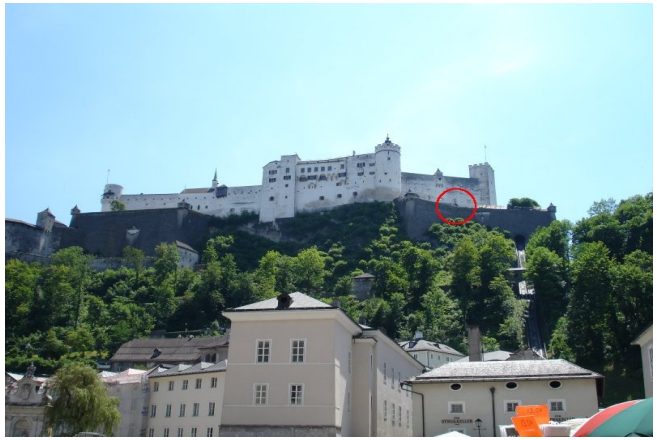
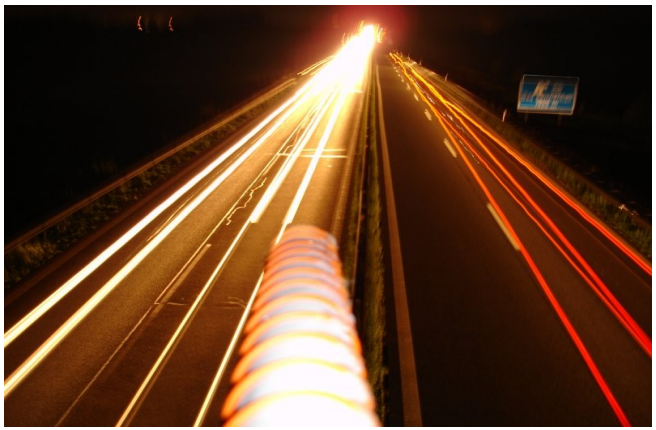
Bluetooone





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Blooover

- Bluetooth Wireless Technology Hoover
  - Proof-of-Concept application
  - Educational purpose only
  - Phone auditing tool
  - J2ME MIDP 2.0 and JSR-82
- Written by Martin Herfurt
- Announced at 21C3 in Berlin

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Blooover

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Blooover II

- Successor of the popular Blooover
  - Auditing tool for professionals
  - More attacks than only BlueBug
  - Not all of the attacks are feasible on J2ME
- To be developed later

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Bloonix

- Linux distribution for Bluetooth audits
  - LiveCD based on Morphix
  - Latest official Linux 2.6 kernel
  - Contains all latest BlueZ utilities
  - Includes also special hacker scripts
  - Graphical interface
  - Report generation
- Not available at the moment

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BluePot

- Bluetooth HoneyPot
  - Runs on J2ME phones
  - Imitates vulnerable phone
  - Logs incoming attacks and device information
  - Strikeback capable
- Written by Martin Herfurt
- Not released yet

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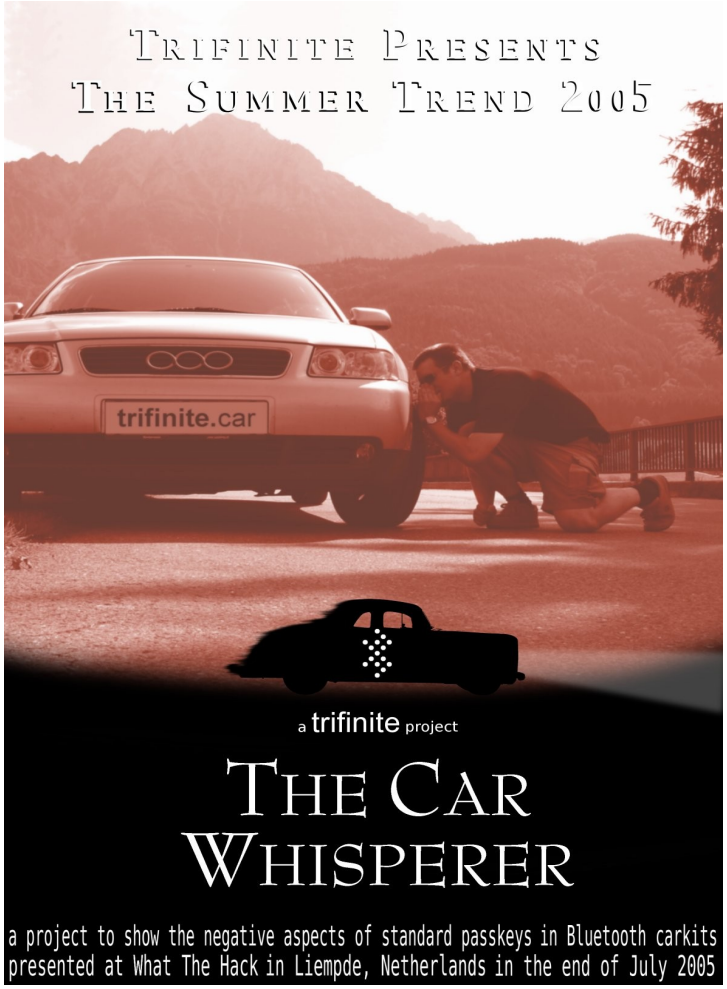
The Car Whisperer

- Use default pin codes to connect to carkits
- Inject audio
- Record audio

- Don't whisper and drive!



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The Car Whisperer

- Stationary directional antenna
  - 15 seconds visibility
  - Average speed of 120 km/h (range 500 m)

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Conclusions

- Bluetooth is secure standard (per se)
  - Problems are at the application level
- Cooperation with the Bluetooth SIG
  - Pre-release testing at UPF (UnPlugFests)
  - Better communication channels
  - Clear user interface and interaction
  - Mandatory security at application level
  - Using a policy manager

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Further information

- trifinite.org
  - Loose association of security experts
  - Public information about Bluetooth security
  - Individual testings and trainings
  - TRUST = trifinite unified security testing
- Contact us via mws05@trifinite.org

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Questions or feedback

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